assessing a patient's ability to use vestibular information to control balance, this test provides a multifaceted assessment of motor responses to challenges to balance. It thus provides an important evaluation of a patient's functional balance capacity that can be used to direct rehabilitative programs.

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Improved Diagnosis of Acoustic Neuroma With Auditory Brain-Stem Evoked Responses and Gadolinium-Enhanced MRI

THE MOST FREQUENT REASON for a clinical suspicion of acoustic neuroma is a unilateral or asymmetric sensorineural hearing loss, although patients may present with persistent vertigo or other neurologic symptoms. As only about 5% of patients undergoing evaluation for an acoustic neuroma will ultimately be found to have a tumor, an efficient and economic diagnostic tree is essential. Following a standard audiometric evaluation, which identifies patients "at risk," auditory brain-stem evoked responses (ABRs) are obtained when there is sufficient residual high-frequency hearing. The ABR is a computer-averaged recording of the changes induced in the electroencephalogram due to sound stimulation. A series of peaks that correspond to different levels in the auditory central nervous system is generated. The results of the ABR are abnormal in more than 95% of patients with proven acoustic tumors. When the latency of the most prominent wave (V) is symmetric and within normal limits, an acoustic neuroma is improbable. The rare false-negative findings generally occur in patients whose acoustic tumors have arisen in the cerebellopontine angle, rather than within the internal auditory canal. False-positive ABR studies are common and indicate the need for an imaging study.

The definitive diagnosis of acoustic neuroma requires an anatomic visualization of the cerebellopontine angle and the internal auditory canal. Contrast-enhanced computed tomographic (CT) scanning reliably visualizes larger tumors but detects less than 50% of tumors that are less than 2 cm in diameter. As the ability to preserve the function of the auditory and facial nerves is highly dependent on tumor size, detecting tumors when they are small is a primary goal in acoustic tumor diagnosis. Recently magnetic resonance imaging (MRI) has become the diagnostic imaging technique of choice in the evaluation of acoustic neuromas, and it has numerous advantages over CT. It provides a noninvasive means of detecting very small tumors that previously would have required gas-contrast CT. False-negative studies appear to be exceedingly rare when a proper slice thickness and imaging technique are used. A few false-positive MRIs have been noted, especially in patients with large internal auditory canals. Within a wide canal that is partially compartmentalized by arachnoid webs, restricted cerebrospinal fluid circulation may lead to an increased protein concentration in the trapped fluid. This returns a bright signal on T2-weighted images. Until recently, adjudicating such equivocal MRI results required gas-contrast CT scans. The introduction of the MRI contrast agent, gadolinium DTPA, however, has rendered this unnecessary. This paramagnetic metal ion, which was recently approved by the Food and Drug Administration, induces a notable increase in the signal intensity of an acoustic neuroma. It has been used in more than 10,000 patients worldwide without significant morbidity. Aside from reducing the incidence of false-positive studies, gadolinium contrast MRI has, in our series, revealed several small tumors that were entirely inapparent on nonenhanced MRI scans. Gadolinium-enhanced MRI also appears to be useful in cases of possible recurrence where differentiating tumor from scar tissue or implanted muscle plug may be difficult using other techniques.

Magnetic resonance imaging also displays surgically important information that was not available on earlier studies. On MRI, the lateral extent of tumor penetration in the internal auditory canal can be evaluated. This both assists the surgeon in planning the operative route (translabyrinthine, retrosigmoid, or middle fossa) and in differentiating an acoustic neuroma from other cerebellopontine angle neoplasms such as meningiomas, which usually do not possess an intracanalicular component. Another advantage of MRI is its ability to visualize intrinsic brain-stem disease such as multiple sclerosis that may mimic the clinical presentation of an acoustic neuroma. In summary, MRI with gadolinium contrast has virtually rendered obsolete all other imaging methods used in diagnosing and characterizing acoustic neuroma. Computed tomography is reserved for those patients known to have metallic implants (MRI hazardous) and in those 5% to 10% of patients who, because of claustrophobia, are unable to tolerate insertion into the magnet.

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Implantable Hearing Aids

ONE OF THE NEW AND EXCITING ADVANCES in otolaryngology and head and neck surgery is the development of hearing devices designed to be implanted in the ear of patients with mixed or conductive hearing loss. These devices have some similarities to cochlear implants used for profound hearing loss, but the indications are different.

At this time two basic types exist. In one type a magnet-containing bone screw is inserted into the mastoid bone behind the ear. A modified hearing aid containing a microphone, amplifier, battery, and an output coil is worn externally with the coil lying over the implanted magnet. Sound amplified by the hearing aid goes to the coil, which energizes the magnet to vibrate the skull so that the patient hears by bone conduction. The ear canal is left open, avoiding problems of drainage and recurrent infection with a tight-fitting